IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of **Krishnamachari, S.** Atty. Docket No.: **PHA 23-431A**
Serial No.: **09/934,962** Group Art Unit: **2623**
Filed: **8/22/2001** Examiner: **Wu, J.**
Title: **COLOR QUANTIZATION AND SIMILARITY MEASURE FOR CONTENT BASED IMAGE RETRIEVAL**

APPELLANT'S BRIEF ON APPEAL UNDER 37 C.F.R. § 1.192

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

This is an appeal from the decision of the Examiner dated 8 July 2002, finally rejecting claims 1-20 of the subject application.

I. REAL PARTY IN INTEREST

The above-identified application is assigned, in its entirety, to Philips Electronics North America Corporation, a company organized under the laws of the State of Delaware.

II. RELATED APPEALS AND INTERFERENCES

Appellant is not aware of any co-pending appeal or interference which will directly affect or be directly affected by or have any bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-20 are pending in the application. Claims 1-20 stand rejected by the Examiner under 35 U.S.C. 102(e).

IV. STATUS OF AMENDMENTS

An amendment is filed concurrently. No other amendments were filed subsequent to the final rejection in the Office Action dated 8 July 2002.

V. SUMMARY OF THE INVENTION

The invention comprises a method and system for characterizing images, and a method and system for comparing images based on this characterization.

The characterization of the image is based on a plurality of measures that are proportional to the frequency of occurrence of a plurality of colors. The image is partitioned into a plurality of partitions. Each partition is characterized by the proportion of colors within the partition, such as: 10% red, 30% green, 35% white, 2% black, 5% yellow, 12% cyan, and so on. The number of different colors used for the characterization is preferably fixed, and based on the expected or observed distribution of colors among a collection of images (Applicant's page 5, line 9 through page 6, line 2). The characterization of the image is a representation of the proportion of occurrences of each color within each partition of the image. For example, if the number of different colors is 64, the characterization of the image comprises the proportion of each of these 64 different colors in each of the partitions. (Applicant's page 7, lines 3-12).

To perform a comparison of images, two images are each characterized as detailed above, providing a characterization representing the proportion of occurrences of each color within each partition of each image. These characterizations are compared by comparing the proportions of similar colors in each corresponding partition of the images. Preferably, to provide for an efficient comparison, only a predefined number of the most popular colors in each partition are compared. If, for example, the four most popular colors in a partition of the first image are red, green, yellow, and black, the four colors in a corresponding partition of the second image that are most similar to red, green, yellow, and black are selected for comparison. The comparison of these four colors includes a comparison of the proportions of each of these most-similar colors in each partition, as well as a measure of the similarity between the colors. Preferably, the similarity-measure is based on the number of occurrences of similar colors, weighted by the degree of similarity between the colors. (Applicant's page 7, line 17 through page 8, line 11.) By comparing the proportions of similar-color pixels in each partition of an image, the comparison process of this invention is less dependent upon such factors as lighting and shading (Applicant's page 8, lines 11-18).

VI. ISSUES

Are claims 1-5 and 11-15 patentable under 35 U.S.C. 102(e) in view of Sato et al. (USP 6,181,818, hereinafter Sato)?

Are claims 6-10 and 16-20 patentable under 35 U.S.C. 102(e) in view of Sato?

VII. GROUPING OF CLAIMS

Claims 1-5 and 11-15 stand or fall together. Claims 6-10 and 16-20 stand or fall together.

VIII. ARGUMENT

Claims 1-5 and 11-15 are patentably distinct from claims 6-10 and 16-20 because claims 1-5 and 11-15 claim a method and system for characterizing images, whereas claims 6-10 and 16-20 claim a method and system for comparing two or more images.

Are claims 1-5 and 11-15 patentable under 35 U.S.C. 102(e) in view of Sato?

Independent claims 1 and 15 each claim a characterization of the image based on a plurality of measures that are ***proportional*** to the frequency of occurrence of a plurality of colors.

Sato teaches creating a histogram of the frequency of occurrences of a plurality of colors in each partition, but does not create a characterization measure that is ***proportional*** to these frequencies of occurrences. Sato uses the histogram of frequency of occurrences to compare each frequency to a threshold value, T(R), to determine whether to include the particular partition in a list of partitions that contain the color. Sato's FIG. 44, steps S174-S175 illustrates the comparison to the threshold T(R), and FIG. 45 illustrates an entry in a list for a given partition size. The array illustrated in FIG. 45 corresponds to the characterization of an image as taught by Sato. Sato refers to this characterization as an "index table" of the image, and specifically states:

> "When the operation shown in FIG. 44 is repeated for all the resolutions (block sizes) R and all the blocks j, index information ***to images and regions*** having a ***predetermined frequency or higher*** of a specific color is stored in the index table ***in units of blocks***." (Sato, column 26, lines 13-19.)

As specifically taught by Sato, the characterization of the image is a table that lists the blocks (partitions) that contain each color above a given threshold amount. If the threshold amount is 10%, for example, a block with a proportion of 15% of a given color will be included in the table at the entry for that color, in like manner, a block with a proportion of 80% of the color will be included, as will a block with 45% and so on. As illustrated in FIG. 45, and as specifically recited above, the entry in the table is the name of the block, only. Sato does not teach the inclusion of the particular percentage of the color of each block in the index table. That is, once the identification of the above example blocks are entered in the table, it is impossible to distinguish which if any of these blocks had a larger or smaller proportion of the color than any other block, because Sato does not store the proportion in the table. In the specific example illustrated in FIG. 45 of Sato, for example, it is ***impossible*** to determine whether "(IMAGE 1, REGION 1)" has more or fewer pixels of color C1 than "(IMAGE 2, REGION 3)". The only thing that is known about these two regions is that each have more than the threshold number of pixels of color C1.

Sato's index table contains names of blocks only, and does not contain a ***measure that is proportional*** to the frequency of occurrences of a color, and, as such, does not anticipate the Applicant's invention as specifically claimed in independent claims 1 and 11, upon which claims 2-5 and 12-15 depend.

Are claims 6-10 and 16-20 patentable under 35 U.S.C. 102(e) in view of Sato?

The Applicant specifically claims a method and system that compares images by ***comparing the frequency of occurrence*** of select sets of colors in each corresponding partition of two images.

Sato teaches the comparison of two images by a comparison of regions of an input image to an index table. The size of each region of the input image determines which column (block size) of the index table is used, and the color/hue of the region identifies the row of the table. The output of Sato's comparison is the list of candidate images found in the index table at the determined row and column, in the form of "candidate image number (image id) and search block number (region id)". (Sato, column 26, lines 19-32). That is, if the predominant color of the input region is C1, and the size of the input region corresponds to a block size of 16, Sato's search of the index table in FIG. 45 will produce two candidate images, and will identify "(IMAGE 1, REGION 1)" and "(IMAGE 2, REGION 3)" as the corresponding similar-size-and-color regions. As noted above, and as illustrated in FIG. 45, the index table does not contain the proportions of color C1 in each of these regions, and thus the comparison process of Sato ***cannot*** compare the proportion of color in the input region to this ***unknown proportion*** in each of the identified regions.

As specifically noted by Sato, the index table is used as a "primary screening operation", and other techniques are used to perform comparisons that are more detailed. (Sato, column 27, lines 15-20). The identification of candidate regions that contain at least a threshold amount of the input color, regardless of the particular proportion of the color in each region, serves to effect this "primary screening operation" with minimal computational complexity.

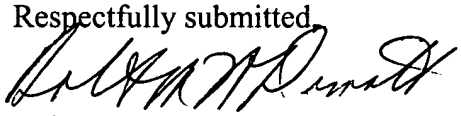
Because Sato does not store the frequency of occurrence of each color in each partition in the index table, Sato cannot be said to effect a comparison of the frequencies of occurrences of select colors in corresponding partitions of two images, as specifically claimed in each independent claim 6 and 16, upon which claims 7-10 and 17-20 depend.

CONCLUSIONS

Because Sato stores only an identifier of each region that contains a threshold amount of each color, and does not store a measure of the proportion of each color in each region, the Applicant respectfully requests that the Examiner's rejection of claims 1-5 and 11-15 under 35 U.S.C. 102(e) be reversed by the Board, and the claims be allowed to pass to issue.

Because Sato stores only an identifier of each region that contains a threshold amount of each color, and does not store the frequency of occurrence of each color in each region for subsequent comparisons, the Applicant respectfully requests that the Examiner's rejection of claims 6-10 and 16-20 under 35 U.S.C. 102(e) be reversed by the Board, and the claims be allowed to pass to issue.

Respectfully submitted,



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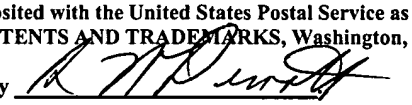
On 7 December 2002 By



APPENDIX

CLAIMS ON APPEAL (as amended concurrently)

1. A method for characterizing an image comprising:

partitioning the image into a plurality of partitions, each partition including a plurality of pixels, each pixel having a color,

determining a frequency of occurrence of each color of the plurality of pixels within each partition, and

creating a characterization of the image that includes a plurality of measures that are proportional to the frequency of occurrence of a plurality of colors.

2. The method of claim 1, further including

quantizing an encoded color of each pixel to provide the color of each pixel.

3. The method of claim 2, further including

identifying a plurality of populous colors, based on the frequency of occurrence of each color, and

the plurality of measures includes proportions of each of the plurality of populous colors in each partition.

4. The method of claim 2, wherein

quantizing the encoded color includes

identifying a set of color centers, and

determining the color of each pixel based upon a color distance between the encoded color of each pixel and each of the set of color centers.

5. The method of claim 1, further including

identifying a plurality of populous colors, based on the frequency of occurrence of each color, and

the plurality of measures includes proportions of each of the plurality of populous colors in each partition.

6. A method of comparing a first image to a second image, comprising

partitioning the first image into a plurality of first partitions, each first partition including a plurality of first pixels, each first pixel having a color,

determining a frequency of occurrence of each color of the plurality of first pixels within each first partition,

partitioning the second image into a plurality of second partitions, each second partition including a plurality of second pixels, each second pixel having a color,

determining a frequency of occurrence of each color of the plurality of second pixels within each second partition

comparing the frequency of occurrence of a select set of colors in each first partition with the frequency of occurrence of a corresponding select set of colors in each second partition.

7. The method of claim 6, further including

quantizing an encoded color of each pixel of the plurality of first pixels to provide the color of each pixel of the plurality of first pixels.

8. The method of claim 7, further including

identifying a plurality of first populous colors, based on the frequency of occurrence of each color of the plurality of first pixels, and

identifying a plurality of second populous colors, based on the frequency of occurrence of each color of the plurality of second pixels; and

wherein

the select set of colors in each first partition corresponds to the plurality of first populous colors, and

the corresponding set of colors in each second partition is based upon a color difference between each of the plurality of second populous colors and the plurality of first populous colors.

9. The method of claim 7, wherein

quantizing the encoded color includes

identifying a set of color centers, and

determining the color of each pixel based upon a color distance between the encoded color of each pixel and each of the set of color centers.

10. The method of claim 6, further including

identifying a plurality of first populous colors, based on the frequency of occurrence of each color of the plurality of first pixels, and

identifying a plurality of second populous colors, based on the frequency of occurrence of each color of the plurality of second pixels; and

wherein

the select set of colors in each first partition corresponds to the plurality of first populous colors, and

the corresponding set of colors in each second partition is based upon a color difference between each of the plurality of second populous colors and the plurality of first populous colors.

11. A system for characterizing an image comprising:

a partitioner that is configured to partition the image into a plurality of partitions, each partition including a plurality of pixels, each pixel having a color, and

an accumulator that is configured to determine a frequency of occurrence of each color of the plurality of pixels within each partition, and

wherein

the system is configured to create a characterization of the image that includes a plurality of measures that are proportional to the frequency of occurrences of a plurality of colors.

12. The system of claim 11, further including

a quantizer that is configured to quantize an encoded color of each pixel to provide the color of each pixel.

13. The system of claim 12, wherein

the plurality of measures are based on the frequency of occurrence of each of a plurality of populous colors in each partition.

14. The system of claim 12, wherein

the quantizer is configured to quantize the encoded color based upon a color distance between the encoded color of each pixel and each of a set of color centers.

15. The system of claim 11, wherein

the plurality of measures are based on the frequency of occurrence of each of a plurality of populous colors in each partition.

16. A system for comparing a first image to a second image, the system comprising:

a similar color determinator that is configured to determine

a mapping between a first set of colors of pixels of the first image and a second set of colors of pixels of the second image, based on a color distance between each of the first set of colors and each of the second set of colors,

the mapping thereby providing a corresponding color in the second set of colors for each color in the first set of colors, and

a similarity determinator that is configured to determine an image similarity measure based on a comparison of a frequency of occurrence of pixels of each of the first set of colors and a frequency of occurrence of pixels of each of the corresponding colors in the second set of colors.

17. The system of claim 16, wherein

the first image is partitioned into a plurality of first partitions,

the second image is partitioned into a plurality of second partitions,

the similar color determinator is configured to determine the mapping between the first and second sets of colors of pixels for each partition of the plurality of first and second partitions, and

the similarity determinator is configured to determine a plurality of similarity measures based on the comparison of the frequencies of occurrence of pixels of each of the first and second set of colors for each partition of the plurality of first and second partitions, and further includes

an accumulator that is configured to provide the image similarity measure based on a composite of the plurality of similarity measures corresponding to each partition of the first and second partitions.

18. The system of claim 17, wherein

the similarity determinator is further configured to determine the similarity measure based upon the color distances between each of the first set of colors and the corresponding color in the second set of colors.

19. The system of claim 16, wherein

the first set of colors of the pixels of the first image is based on a quantization of encoded colors of the pixels of the first image.

20. The system of claim 17, wherein

the quantization of encoded colors is based on a color distance between the encoded color of each pixel and each of a set of color centers.